REDESCRIPTION OF THE TROPICAL WEST AFRICAN PLEUROBRANCHID *PLEUROBRANCHUS RETICULATUS* RANG, 1832 (GASTROPODA: OPISTHOBRANCHIA)

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Abstract Pleurobranchus reticulatus *Rang, 1832 is redescribed from specimens collected in São Tomé Island (Gulf of Guinea, W. Africa). A detailed description of both the external and internal anatomy is given, in particular of the shell, jaws, radula and, for the first time, the reproductive system. This structure is herein described for the first time. Ontogenetic variation of the colour pattern is also presented. This species is compared with other eastern Atlantic species of this genus.*

Key words *Opisthobranchia,* Pleurobranchus, Pleurobranchus reticulatus*, São Tomé Island, West Africa.*

INTRODUCTION

Pleurobranchus reticulatus was described by Rang (1832) from specimens from "Baie de Saint-Antoine" in the Gulf of Guinea. Although the exact location of this bay is unknown, it is probable that it refers to San Antonio Bay in Principe Island (Republic of São Tomé and Principe; 01º38'N – 07º25E) or San Antonio de Palea (Republic of Guinea Equatorial; 01º26'S – 05º37E). Pilsbry (1895-6) and Vayssière (1898) included this species in their monographs, but simply copied the text and figures of Rang's description. Cervera *et al*. (1996) re-identified one specimen from Ghana previously attributed to *P. areolatus* Mörch, 1863 by Edmunds (1968) as *P. reticulatus*. In the present paper, we give a detailed description of *P. reticulatus* based on specimens recently collected in São Tomé Island. We also shed light for the first time on the anatomy of the reproductive system and the development of the colour pattern during ontogeny.

SYSTEMATICS

Nudipleura Wägele and Willan, 2000

Family Pleurobranchidae Gray, 1827
Genus *Pleurobranchus* Cuvier, 1804
Type species: *Pleurobranchus peroni* Cuvier, 1804

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Pleurobranchus reticulatus Rang, 1832

Material examined Six specimens of *P. reticulatus* were collected by one of us (G.C.) by SCUBA at Ponta da Baleia, São Tomé Island (00º01'N – 06º33E), February 2005. All specimens were collected by hand under boulders. The three smaller ones (5, 9 and 26 mm) were found at greater depths, between 8 to 22 m, whereas the largest ones (30, 40 and 50 mm) were collected in shallower waters, about 3 to 5 m deep.

The two largest specimens (40 and 50 mm long) were dissected to study internal anatomy.

Voucher specimens are deposited at the Instituto Português de Malacologia (Portugal), under the reference numbers IPM.003.MO (specimen 5 mm long), IPM.004.MO (9 mm), IPM.005.MO (40 mm), IPM.006.MO (50 mm), and at the Museo Nacional de Ciencias Naturales, Madrid (Spain), under the calogue number MNCN 15.05/46746 (26 mm), MNCN 15.05/46746 (30 mm).

DESCRIPTION

EXTERNAL ANATOMY AND COLOURATION

Oval body. Mantle notched anteriorly, the oral veil protrudes slightly from it. Rhinophores involute and basally joined. Posterior end of the foot projects from the mantle. Gill not visible in living specimens, as it is covered by the mantle. This organ, placed at the right-hand side of the body,

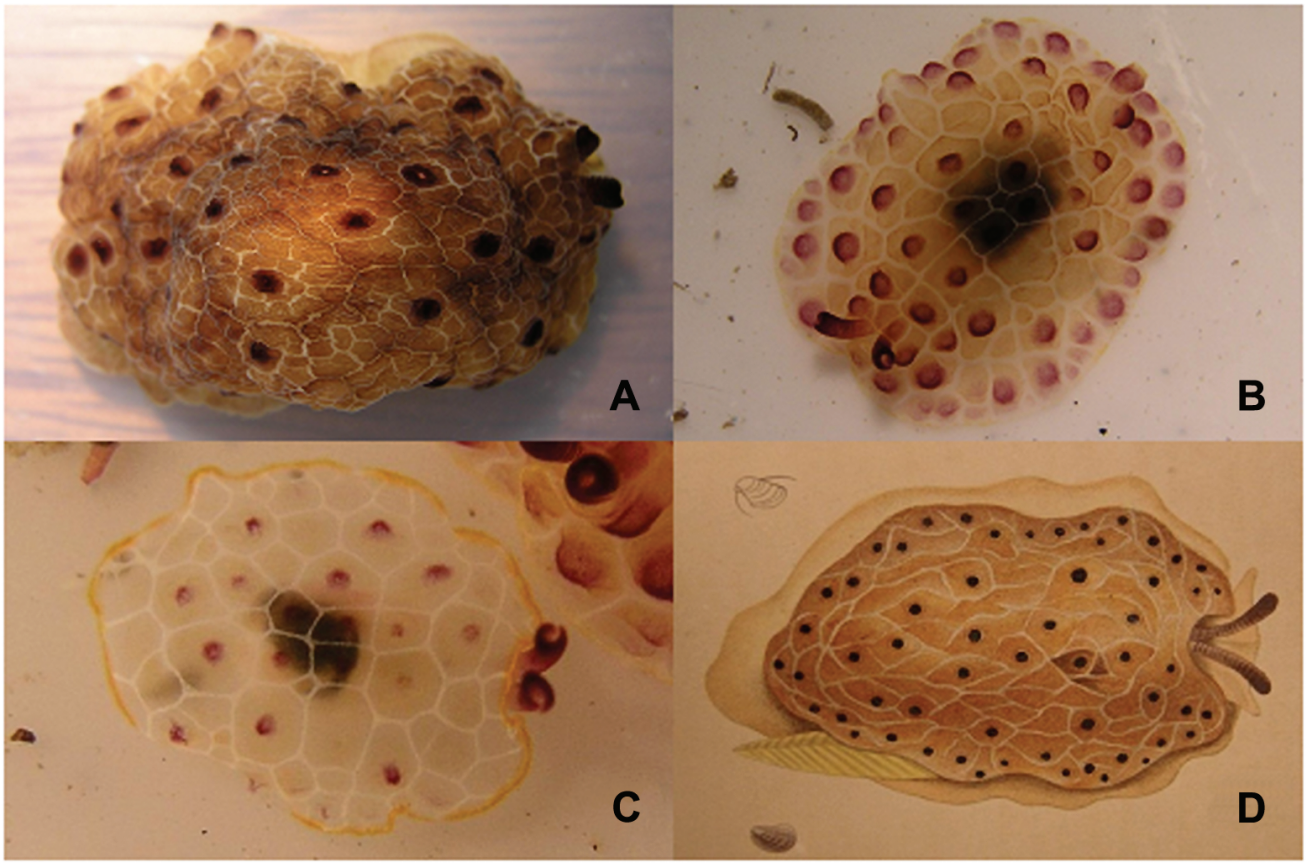

Figure 1 *Pleurobranchus reticulatus* **A** specimen 50 mm long **B** specimen 5 mm long **C** specimen 9 mm long **D** specimen 75 mm long, after Rang (1832).

is bipinnate with 23 pinnae on each side of the axis. Gill rachis and axes of pinnae tuberculate. Tubercles are organized in a double alternating and conspicuous row. Gill united to the body for approximately three quarters of its length. Anterior edge of the foot bilabiate. Conspicuous pedal gland in the posterior region of the pedal sole.

Genital apertures located anteriorly to the gill. At the anterior side of the penis, which is narrower towards the tip, there is a leaflet structure. Vaginal aperture located between the penis and the gill surrounded by two wide flaps in a complex arrangement. Anus located at the posterior end of the gill.

Ground colour light brown with deep, opaque white reticulation that delimits polygonal areas of different sizes and shapes (Figure 1A). This results in a patchy pattern and inside all areas it is possible to identify another reticulation. The latter is more delicate, with thin waving lines and does not necessarily create delimited areas. Several dark brown and rounded tubercles of fairly constant size are arranged in the middle of some of the polygonals. The tubercles are darker in the centre than at their edges. Oral veil yellowish-brown; rhinophores dark-brown and gill pale yellow. Foot semi-transparent and yellowish brown, although the upper side is pale yellow (more intense than in the base) with an opaque white net, similar to that on the mantle but without the tubercles.

However, during ontogeny the colour pattern changes. In an early stage, a specimen 5 mm long (Figure 1B) has a semi-transparent whitish ground colour. A complex opaque white network is present and is organized, as in the adults, into irregular polygons. The tubercular spots are purple rose. All around the border of the mantle there is a conspicuous yellow line. Rhinophores are slightly darker than the tubercular spots, especially in their distal third. The pattern of a bigger specimen, 9 mm long (Figure 1C), has developed into a semi-transparent yellowish brown ground colour with a complex yellow-white

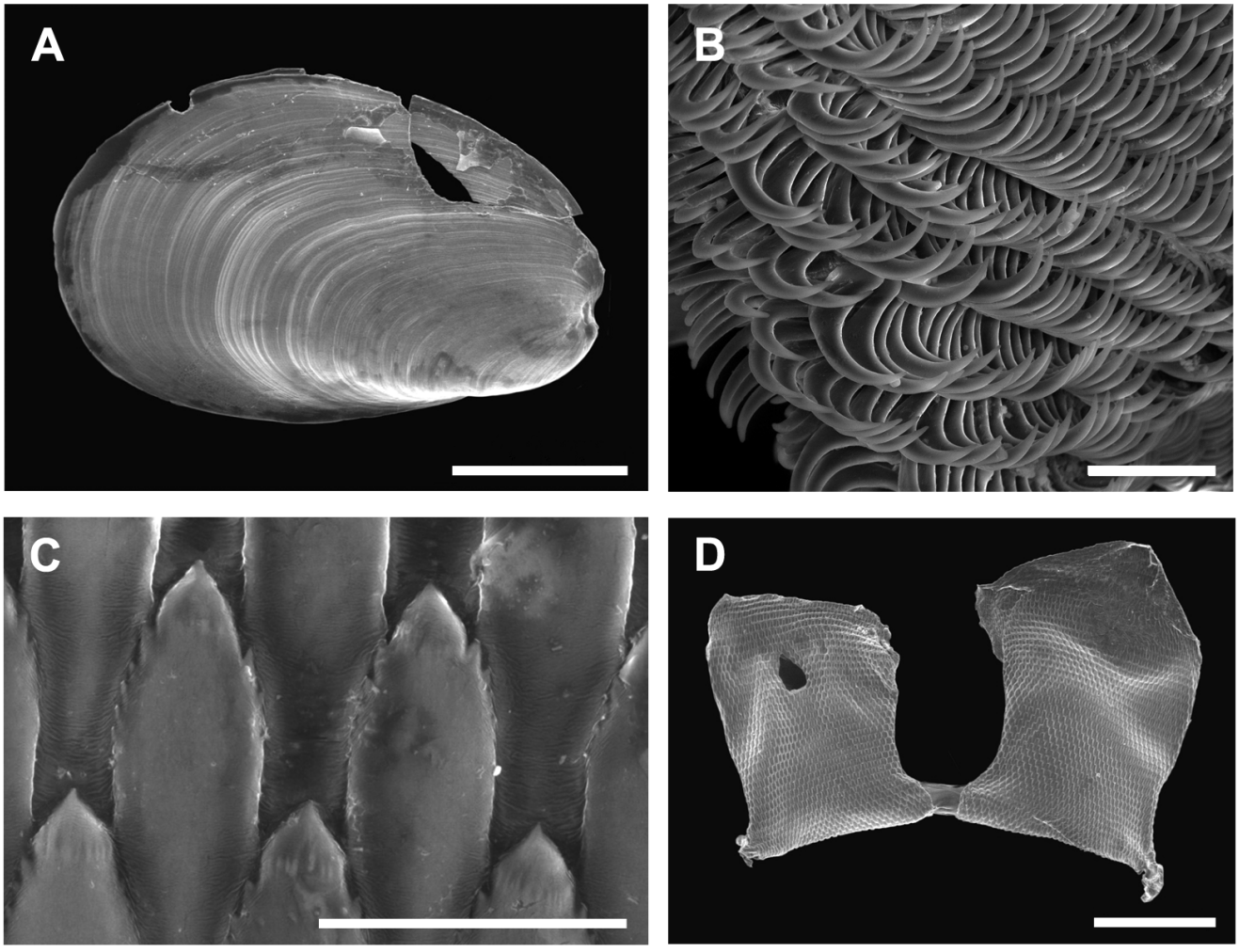

Figure 2 *Pleurobranchus reticulatus* SEM micrographs of hard structures. **A** shell (scale bar = 2 mm); **B** detail of the radula (scale bar = 100 µm); **C** detail of jaw platelets scale bar = 100 µm); **D** jaws (scale bar = 1 mm).

network. It has rounded tubercular spots in different shades of purple. Rhinophores are also darker than the tubercular spots, as in the smallest specimen observed. At this stage the yellow line that borders the mantle is interrupted and probably irrelevant to the main colour pattern. Animals more than 26 mm no longer show this character. Comparing all studied specimens it is possible to infer that this yellow line fades away during ontogeny.

INTERNAL ANATOMY

No spicules were found in the tissue of the mantle or in the foot.

The shell is brownish in colour, oval in shape and located anteriorly to the right over the digestive gland, above the pericardium. It is 7 mm long and 4.5 mm wide for the 50 mm specimen and 7 mm long and 4 mm wide for the 40 mm specimen. Growth lines are noted by the variation of colour intensity (Figure 2A), with the lighter parts corresponding to depressions and the darker ones to elevations. In the first third of the teleoconch some longitudinal lines are visible, forming a reticulated pattern where they intersect with the growth lines. This pattern totally fades away in the distal part of the shell. The protoconch is lighter in colour, has about one spire and lacks any ornamentation.

Jaws (Figure 2D) are 5 mm long and 3 mm wide for the 50 mm specimen and 4 mm long and 2 mm wide for the 40 mm specimen, possessing elongated cruciform elements that have a prominent cusp flanked by 3 to 5 short denticles on each side (Figure 2C).

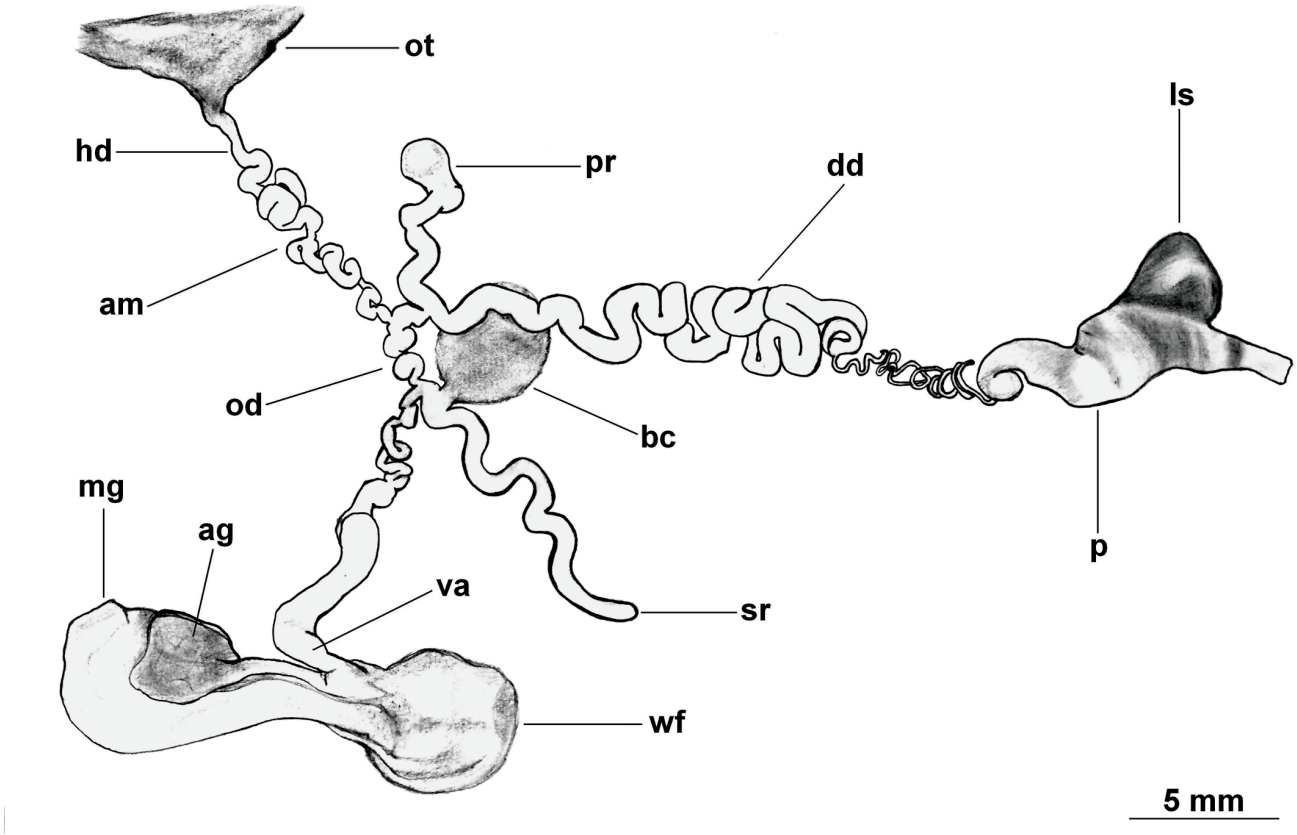

Figure 3 Reproductive system. Key: ag, albumen gland; am, ampulla; bc, bursa copulatrix; dd, deferent duct; hd, hermaphroditic duct; ls, leaflet structure; mg, mucus gland; od, oviduct; ot, ovotestis; p, penis; pr, prostate; sr, receptaculum seminis; va, vagina; wf, wide flaps.

Radular formula 58 × 180.0.180 (specimen 50 mm long alive) and 62 × 160.0.160 (specimen 40 mm long alive). Radular teeth smooth and hook-shaped (Figure 2B).

Reproductive system (Figure 3) with a triaulic arrangement. Most of the hermaphroditic duct is morphologically differentiated as a convoluted ampulla. The hermaphroditic duct forks into a deferent duct and a very short oviduct. The prostate is a thin, short and not very convoluted structure arising from the beginning of the deferent duct, which is very long and highly convoluted. Its distal portion narrows and enters the penial papilla, which is large and ends in a long, hook-shaped, penis. Bursa copulatrix large and rounded, thinly walled. Receptaculum seminis elongate, slightly convoluted. Their short ducts join before entering the short oviduct.

The vaginal duct is very convoluted and becomes wider near the female gland orifice. In the inner structure of the nidamental gland complex, two different structures are evident: the mucus gland and the rather spherical albumen gland. The mucus gland envelops the albumen gland partially, which occupies about one third of the whole dimension of the nidamental gland complex, and opens into a short and narrow duct. This duct ends as the genital atrium, close to the vagina.

DISCUSSION

Pleurobranchus reticulatus is one of the five Atlantic-Mediterranean species of the genus with a white/whitish mantle network.

After its original description by Rang (1832), *Pleurobranchus reticulatus* was cited only twice, by Pilsbry (1895-6) and Vayssière (1898). However, both authors simply transcribe the original description. Cervera *et al*. (1996) identified a specimen from Ghana as *P. reticulatus* based on Edmunds (1968; Fig. 2A as *P. areolatus*), which exactly matches that of our larger specimens (Figure 1A).

As noted by Cervera *et al*. (1996), *P. reticulatus* differs from *P. garciagomezi* Cervera, Cattaneo-Vietti and Edmunds, 1996 in the reticulated pattern of the mantle and the shape of the shell. *P. garciagomezi*

has a thicker white reticulation and no dark tubercles are found inside polygonal areas. These tubercles, however, are always present in the adults of *P. reticulatus*. Furthermore, the white reticulation is always thinner than in *P. garciagomezi*. This species has a spatulate shell whereas that of *P. reticulatus* is oval. According to Vayssière (1898), in *P. forskali* Rüppell and Leuckart, 1828 the shell is "oval, almost round".

The radular teeth of *P. reticulatus* have the same shape as those found in *P. garciagomezi* and *P. forskali*. All three species have similar jaw elements, with marginal denticles on each side (see Cervera *et al*., 1996; Vayssière, 1898; Thompson, 1970). Moreover, in *P. reticulatus* no differences were found in the shape of these mandibular elements according to their location on the jaws, contrary to that observed by Cervera *et al*. (1996) in *P. garciagomezi*.

Cervera *et al*. (1996: Figure 4) represent the reproductive system of *P. garciagomezi* in which a bursa copulatrix with a long duct, a very long hermaphroditic duct, and a narrow prostate which discharges into a very small duct can be seen. In *P. reticulatus* we found these structures to be quite different. Moreover, the drawing by Cervera *et al*. (1996) shows a single female gland complex whereas in *P. reticulatus* we were able to distinguish two glands, one inside the other.

The reproductive system of *P. reticulatus* is also different from that of *P. areolatus* as described by Cervera *et al*. (2000). *P. reticulatus* has a longer deferent duct which gets narrower in the distal part, whereas in *P. areolatus*, this structure is very short. On the other hand, the seminal receptacle of *P. reticulatus* is uniform in section whereas that of *P. areolatus* gets wider distally. These authors also draw a single female gland, as seen for *P. garciagomezi*.

The reproductive system of *P. forskali* as described by Vayssière (1898) is more similar to that of *P. reticulatus*. Nevertheless, in *P. forskali*, the seminal receptacle has a granular appearance, is short and not convoluted. Also the prostate has a very short duct and the deferent duct is not narrowed distally. It is also noteworthy that a smaller gland inside the female gland is found in *P. forskali* as well.

Geographic distribution

To date *P. reticulatus* is restricted to the Gulf of Guinea, West Africa. Vayssière (1898) recalls the fact that Rang (1832) reported this animal from the "baie de Saint-Antoine" although the exact location is not known, possibly a place named San-Antonio bay in Principe Island 01º38'N – 07º25E (Republic of São Tomé e Príncipe) or San Antonio de Palea in Annobon Island, 01º26'S – 05º37E (Equatorial Guinea). Edmunds (1968) reported *P. reticulatus* from Ghana (as *P. areolatus*).

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